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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1991

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INTRODUCTION

The 1991 growing season began with excellent conditions for planting and growth. Soil moisture was good, but already in late May soil moisture was beginning to become deficient and the remainder of the season was characterized by drought along with above average temperatures. Production in the state was about 350,000 tons, a decrease of 17% from a year ago. Acreage for harvest was about 16,200 acres, slightly down from last year and the average yield per acre about 21.5 tons/acre, 15% below last year's average yield.

New growing methods machine harvest-bulk handling and new processing technology require a continuous supply of better suited varieties for the industry to remain competitive. Ohio continues to be the second largest processing tomato production state in the United States. This breeding work continues to be directed with emphasis on improvement of the whole-canned tomato (whole-pack) and tomato suitable for diced product. Other needs of the canner are also being given attention in relation to development of improved varieties for the processor of various juice, sauce and paste products.

Selection for earliness and improved fruit setting ability, especially during periods of heat stress, is being carried out to reduce the problem of split fruit set and make possible more uniform tomato harvest schedules. Other important characteristics being selected to make machine harvest and bulk handling more efficient include crack resistance, firmness and ability of ripe fruit to store well on the vine for extended periods to allow maximum productivity in machine harvest. Breeding and selection was continued for resistance to Early blight (*Alternaria solani*), anthracnose (*Colletotricum* spp.), and the Fusarium (*Fusarium oxysporum* (I)), and Verticillium (*Verticillium dahliae* (Ve)) wilts.

Improved quality factors being selected for and intensively evaluated for in cooperation with commercial processors include: acidity, pH, soluble solids, viscosity, color (crimson fruit color [og^c], and especially fruit attributes conditioning efficient lye or steam peeling characteristics and corelessness. This includes improvement of raw products suitable for sauce, soup, ketchup, and other tomato products.

For whole-canned production, Ohio 7983 and Ohio 8245 continued to constitute a major proportion of 1991 commercial acreage. Ohio 7983 is replacing Ohio 7814 as an early-main season type and is similarly well suited for whole-pack and

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diced product. 08245 continued to perform well as a new productive main season variety; its excellent disease resistance and quality attributes of color and solids continue to be noteworthy; it is widely used for whole and diced pack as well as for sauce and other tomato product.

The attempt to utilize improved color crimson gene ($\underline{og^c}$) continued with development of Ohio 8556 and pilot commercial acreage of this cultivar did well; it is a jointless Verticillium-Fusarium resistant line with excellent whole pack-diced product quality. Improved color potential continues to be a major objective in the breeding program and several new lines are promising.

Ohio 7814 acreage continues to be substantial and is proving to be a valuable asset as an early-main season Fusarium resistant, jointless pedicel, machine harvest type with excellent firmness, holding ability and resistance to fruit rots. It is especially suited for coreless wholepack and diced pack, as well as pureed product manufactured.

Ohio 8550 was also in advanced trial; its earliness is a major attribute; productivity and quality is good. It has jointless fruit stem and is Verticillium-Fusarium resistant.

The early Ohio hybrids OX 1 and OX 4 were tested extensively and showed promise. Also, this year the following new Ohio hybrids were evaluated and performed well: OX 6, OX 9, OX 38 and OX 42. The use of hybrid processing tomato cultivars is increasing and exhibit potential for making possible more rapid improvements in productivity and disease resistance in comparison with inbreds (open pollinated cultivars). Hybrid cultivars exhibit consistent yield advantages over open pollinated varieties. Multiple disease resistance can be incorporated into hybrids more readily and they have potential for improved earliness and more dependable performance under stress conditions.

Seed is being produced of the open pollinated cultivars as well as the hybrids. In addition to station trials, pilot commercial trials with grower-canners will be continued in 1992.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, fall bedded (November).

Fertilizer: 800 lb. per acre of 0-26-26 (October); 220 lb. per acre of 34-0-0 (May).

Herbicide: 2 pt/A Devrinol incorporated May 15; Sencor directed spray 0.66 lb./A June 18.

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 8.

Transplanted to Field: May 20, a two-row transplanter using 21-53-0 starter at 5 lb. per 100 gal. of water; 1/2 pint per plant.

Plot Size and Spacing: Single-row plots, 20 plants per row spaced 12 inches, rows 5 feet apart.

Insect and Disease Control: Standard recommended program followed for insect and disease control.

Weather Data (OARDC, Fremont, Ohio)

	Temperature		Rainfall (inches)	
	1991	39 Yr. Avg.	1991	39 Yr. Avg.
April	53.0	48.8	3.73	3.37
May	66.9	59.6	2.88	3.69
June	71.5	69.2	2.63	3.95
July	72.8	73.0	2.91	3.92
August	70.2	70.9	1.79	3.57

HARVEST INFORMATION

Drought conditions and above average and record high temperatures characterized the season with resultant stress to the crop. Harvest was earlier than normal and dry conditions at harvest did allow for good recovery rates.

Harvesting was with a Johnson tomato harvester and was carried out when the entries were estimated to be at a stage of fruit ripeness in which yields of marketable fruit were approaching optimum recovery with a minimum of green and cull fruit (Tables 1 & 2). Percentages reported of fruit recovery are on a weight basis.

The data for the new experimental lines is organized according to maturity groups and within maturity by once-over machine-harvest fruit yield (Tables 1 & 2). Because of the complexity of factors which determine a potentially successful variety, other factors which must be considered and that can be limiting are included; eg., fruit concentration, fruit cull percentage, fruit size, stemming character, and jointlessness. To adequately evaluate promising lines at least one or two more years of testing will be necessary.

QUALITY EVALUATION

Field-run tomatoes were used for quality evaluation; the sample was cut in half, quartered, extracted in a Food Processing Equipment Co. laboratory pulper, and de-aerated (Table 1a).

1. Hunter Color Difference Meter (CDM).
2. Percent Soluble Solids: Abbe Refractometer
3. Percent Total Acid as citric: The raw sample used for pH determination was directly titrated using 0.1 normal sodium hydroxide solution to a pH of 8.1.
4. pH was determined by the glass electrode method.
5. Viscosity potential; hot break-finish-capillary-60 second flow basis.

Seed Sources and Cooperators

1. S.Z. Berry, Dept. of Horticulture, OSU-OARDC, Wooster, OH.
2. F. Cortelyou, Hunt-Wesson Foods, Inc., Perrysburg, OH.
3. D. Ematty, H.J. Heinz Co., 13737 Middleton Pike, Bowling Green, OH
4. K. Haack, Tiffin, OH.
5. J. Hirzel, Hirzel Canning Co., Toledo, OH.
6. K. Wagner and W. Springer, Terra-Vegetable Div., Carmel, IN.

Table 1. Trial I. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio 1991.

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 7/15/91					
O X 5	25.3	84	14	3	2.3
O X 4	22.8	81	16	3	2.4
O 87160	21.9	81	17	2	2.0
O X 1	21.2	79	18	3	2.4
O 7814	19.1	79	17	4	1.9
O 88119	18.9	75	23	2	2.0
O 90137	18.8	82	15	3	1.9
O 88122	18.5	81	15	4	2.1
Harvest Date 8/21/91					
O 8556	24.7	92	3	6	2.4
O X 7	24.0	91	4	5	2.5
O X 2	23.7	93	2	5	2.1
O 7983	23.6	92	3	6	2.1
O 90131	23.5	93	3	3	2.1
O 8550	21.7	84	4	12	2.4
O 8991	21.6	92	4	4	1.9
Harvest Date 8/28/91					
Peto 696	30.2	92	3	6	2.3
O X 38	29.7	93	2	6	2.0
O X 6	28.4	88	4	8	2.5
O X 42	26.8	92	2	5	2.0
O 8446	26.0	91	3	6	2.4
O X 9	24.9	89	3	8	2.6
O 8245	24.4	90	4	7	2.2
O 87175	24.2	90	2	8	2.0
O 90139	24.2	87	2	10	2.1
Peto 2196	24.0	89	3	7	2.2
O 86120	23.6	86	2	12	2.4
O 88110	23.4	86	3	11	2.1
O 90128	23.1	86	4	10	2.3
O 8675	22.6	91	1	7	2.1
O 8994	22.5	81	5	14	2.8
O 88144	22.4	85	3	13	2.2
O 8986	22.2	77	6	17	2.2
O 8444	22.1	84	3	14	2.0
O 88164	21.7	87	2	11	2.0
O 8690	21.4	83	4	13	2.4
O 88129	21.2	83	4	13	2.1
O 88154	19.4	86	6	9	2.1
O 90134	19.4	82	6	12	2.3
O 90135	19.1	86	4	10	2.2
O 90116	18.0	81	5	14	2.6
LSD .05	6.4				0.3

Table 1a. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, OH 1991.

Variety or Test Line	pH	% Total Acid as Citric	% Soluble Solids	Hunter CDM L	Hunter CDM a/b
O X 5	3.6	0.31	4.6	42.7	1.3
O X 4	3.5	0.36	5.2	45.6	1.4
O 87160	3.6	0.25	4.9	46.4	1.2
O X 1	3.6	0.38	5.0	45.3	1.3
O 7814	3.7	0.34	4.7	44.6	1.3
O 88119	3.7	0.28	4.6	36.0	1.1
O 90137	3.7	0.27	5.0	35.8	1.1
O 88122	3.7	0.33	5.6	50.9	1.2
O 8556	3.6	0.27	4.9	54.1	1.3
O X 7	3.6	0.32	5.1	46.6	1.4
O X 2	3.5	0.31	5.1	44.6	1.2
O 7983	3.6	0.31	5.1	46.1	1.2
O 90131	3.7	0.32	4.9	48.2	1.4
O 8550	3.7	0.31	5.0	44.5	1.4
O 8991	3.5	0.32	5.4	44.8	1.3
PS 696	3.5	0.35	5.0	47.1	1.3
O X 38	3.7	0.25	4.7	50.0	1.3
O X 6	3.5	0.36	5.2	46.5	1.3
O X 42	3.6	0.36	4.8	39.4	1.3
O 8446	3.6	0.30	4.7	57.1	1.3
O X 9	3.5	0.35	4.8	46.7	1.4
O 8245	3.5	0.36	5.1	34.5	1.1
O 87175	3.7	0.34	5.6	45.9	1.4
O 90139	3.5	0.29	5.8	49.3	1.3
PS 2196	3.5	0.40	5.6	47.6	1.3
O 86120	3.7	0.31	5.1	54.3	1.4
O 88110	3.7	0.35	5.7	46.6	1.4
O 90128	3.6	0.36	5.5	51.5	1.3
O 8675	3.6	0.38	4.8	26.6	1.1
O 8994	3.6	0.33	4.9	49.2	1.4
O 88144	3.6	0.33	5.0	52.3	1.2
O 8696	3.7	0.28	5.3	40.8	1.3
O 8444	3.6	0.36	5.7	50.7	1.3
O 88164	3.5	0.35	5.6	44.6	1.2
O 8690	3.7	0.32	5.4	45.2	1.4
O 88129	3.6	0.30	5.4	48.7	1.3
O 88154	3.6	0.26	4.7	46.6	1.3
O 90134	3.7	0.29	5.3	42.4	1.4
O 90135	3.7	0.29	5.4	45.8	1.4
O 90116	3.6	0.36	5.5	41.4	1.6

Table 1b. OSU Machine Harvest Trial I. Quality Evaluation (Hunt-Wesson Lab) Fremont, OH 1991

Cultivar	pH	Raw Brix	Viscosity Potential Index cases/ton (72/8 oz. sauce)
O 7814	4.3	5.1	24.3
O 7983	4.0	5.3	32.1
O 8245	4.2	4.8	33.3
O 8444	4.3	5.4	28.6
O 8446	4.3	5.2	33.8
O 8550	4.3	5.1	30.2
O 8556	4.3	5.4	26.1
O 86120	4.0	5.0	26.7
O 8655	4.4	4.9	29.6
O 8675	4.3	5.2	32.3
O 8687	4.0	5.5	30.4
O 8689	4.0	5.3	27.7
O 8690	4.5	5.2	27.8
O 87160	4.4	4.4	33.5
O 87175	4.4	5.6	26.4
O 88110	4.4	5.2	30.9
O 88119	4.0	4.7	35.6
O 88122	4.4	6.0	34.2
O 88129	4.3	5.7	36.7
O 88144	4.4	5.2	28.6
O 88154	4.4	4.7	35.4
O 88164	4.4	5.4	32.5
O 8986	4.5	4.7	36.9
O 8991	4.2	4.9	35.2
O 8994	4.4	5.2	36.7
O 90116	4.4	5.6	33.1
O 90127	4.3	5.2	29.8
O 90128	4.4	4.9	26.0
O 90131	4.2	5.2	33.3
O 90134	4.4	5.4	32.1
O 90135	4.4	5.4	34.4
O 90137	4.4	4.4	33.1
O 90139	4.4	6.1	38.9
O 90141	4.3	5.3	30.9
O X 1	4.3	5.1	31.9
O X 2	3.9	5.1	33.5
O X 4	3.9	5.3	34.0
O X 5	4.4	4.9	35.2
O X 6	4.0	5.0	31.3
O X 7	4.0	5.4	34.4
O X 9	3.9	5.1	32.5
O X 38	4.0	4.7	35.6
O X 42	4.3	4.3	31.9
PS 2196	3.8	5.4	35.2
PS 696	4.3	4.9	32.7

Table 2. Trial II. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio 1991.

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 9/2/91					
O X 58	34.1	86	4	10	2.4
O X 42	30.6	90	2	9	2.0
O Y3998-1	30.6	92	2	6	2.0
O X 9	30.2	80	2	18	2.4
O X 60	29.9	85	3	12	2.4
O X 88	29.7	85	4	11	2.0
O X 7	29.3	85	2	13	2.5
Peto 696	29.2	87	3	11	2.2
O X 32	29.1	89	4	7	1.9
O X 52	28.7	86	2	12	1.8
O 8245	28.5	91	2	7	2.3
O X 8	27.6	80	1	19	2.2
O X 6	27.3	84	2	13	2.5
O X 3	26.8	89	3	9	1.9
O X 15	26.6	85	2	13	2.3
O X 38	25.7	83	1	16	1.8
O X 64	24.7	80	6	14	1.9
O 8444	24.3	90	2	8	2.2
O 90385	23.5	89	1	10	2.0
Peto 696	23.0	91	4	5	1.9
O X 2	22.6	80	2	18	1.9
O 8556	22.4	82	1	17	2.2
O 90392	22.0	84	1	14	2.0
H 6285	21.8	83	5	11	2.7
O 90393	21.6	78	1	21	2.1
O 7983	21.3	87	3	10	2.0
O X 34	20.9	82	4	14	2.4
O 8245	20.9	90	4	6	2.2
O 7814	20.7	83	2	15	1.9
O 90394	20.1	76	2	22	2.2
O X 62	19.8	73	11	16	2.3
O 90395	19.5	80	4	16	2.1
O X 95	18.8	81	3	16	2.1
O 90388	18.5	84	5	11	2.0
O 7814	18.4	88	4	8	2.0
O 90383	18.3	88	2	11	2.1
O 90381	17.6	84	2	15	1.8
O Y3922-1	17.0	87	1	12	2.1
O Y1290-1	16.6	88	2	10	2.1
O X 24	16.3	76	8	16	2.3
O 90387	14.8	72	13	16	1.9
LSD .05	9.5				0.3

Table 2. Trial II. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio. 1991. (cont.)

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 7/15/91					
O X 46	23.1	85	13	2	2.1
O X 70	19.1	77	19	4	2.1
O X 61	19.0	76	16	8	1.8
O Y3934-1	18.2	76	21	3	2.4
O X 4	17.6	73	24	3	2.5
O X 17	16.1	77	18	4	2.2
O 90386	15.4	76	19	4	2.2
O Y3962-1	15.0	78	18	5	1.7
O 90382	13.0	87	9	4	1.7
O 8442	11.8	79	8	13	1.8
Harvest Date 8/21/91					
O X 54	29.7	91	3	5	2.5
O X 53	28.2	94	2	4	2.0
O X 4	28.0	92	3	5	2.4
O X 49	28.0	85	4	11	2.4
O X 5	27.4	90	4	6	2.2
O X 93	25.7	91	5	4	1.9
O Y1290-2	24.0	92	4	4	2.0
O Y3936-1	24.0	92	4	5	2.0
O 7983	22.2	91	4	5	2.0
O Y3933-1	21.3	89	4	6	2.3
O X 1	19.6	92	1	7	2.2
O Y1290-3	19.2	93	3	5	2.1
O 90389	15.7	81	8	12	2.4
O 90390	13.8	90	5	5	1.8
LSD .05	9.5				0.3

Table 3. Grower trial (K. Haack): Observation-harvest (harvested plot size sample 1/500 acre). Tiffin, OH. 1991.

Cultivar	Ripe (tons/A) (9/5/91)	Maturity Rating (% ripe 8/6/91)
O X 38	59.4	49
O X 42	47.6	27
O X 34	47.4	63
O 88164	47.4	50
O X 6	46.4	63
O X 3	46.1	42
O X 2	45.5	59
O 7814	43.6	40
O X 7	43.6	58
O 8994	43.3	60
O X 15	42.9	69
O 87160	40.5	57
O 8556	40.4	50
P 696	39.1	40
O X 4	38.5	73
O 8245	38.1	37
O 7983	38.0	57
O X 1	37.4	81
O 8550	35.1	62
O 88119	34.4	63
O 8446	33.6	45
P 696	33.1	55
O 8986	31.5	56

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